Epidemiological Studies about Vitamin D status in pregnant women

Vineet Vishnoi[1], Rajesh Kumar Jha[2], D.K.Awasthi[3] and Gyanendra Awasthi*[4]

1: Department of Chemistry, DAV (PG) College, Dehradun
2: Department of Pathology, DIBNS, Dehradun
3: Department of Chemistry, JNMPG College, Lucknow
4: Department of Biochemistry, DIBNS, Dehradun

Abstract: *Vitamin D* refers to a group of fat-soluble secosteroids It is essential for maintaining healthy bones and teeth. It also plays many other important roles in the body, including regulating inflammation and immune function. The present paper discuss different studies about Vitamin D status in pregnant women.

In a study High Prevalence of Vitamin D Deficiency in Pregnant Women: A National Cross-Sectional Survey conducted by **Stefanie vandevijvere *et al*; 2012,** during 2010-2011 in Belgium. The women were selected via a multi-stage proportionate-to-size sampling design. Blood samples were collected and a questionnaire was completed face-to-face. 55 obstetric clinics were randomly selected and 1311 pregnant women participated in the study. The median serum 25-hydroxyvitamin D [25-(OH)D] concentration was significantly lower in the first trimester (20.4 ng/ml) than in third trimester (22.7 ng/ml). Of all women, 74.1% (95%CI = 71.8–76.5%) were Vitamin D insufficient (25-(OH)D ,30 ng/ml), 44.6% (95%CI = 41.9–47.3%) were Vitamin D deficient (25-(OH)D,20 ng/ml), while 12.1% (95%CI = 10.3–13.8%) were severely Vitamin D deficient (25-(OH)D ,10 ng/ml). Of all women included, 62.0% reported taking Vitamin D-containing multivitamins, of which only 24.2% started taking those before pregnancy. The risk of Vitamin D deficiency (25-(OH)D< 20 ng/ml) was significantly higher for less educated women and women who reported not going on holidays to sunny climates. The risk of severe Vitamin D deficiency (25-(OH)D < 10 ng/ml) decreased for women who reported alcohol consumption during pregnancy, decreased with more frequent use of sunscreen lotion and increased for smokers and women who reported preference for shadow. In conclusion, Vitamin D deficiency is highly prevalent among pregnant women in Belgium and this raises concerns about the health consequences for the mother and the offspring. A targeted screening strategy to detect and treat women at high risk of severe Vitamin D deficiency is needed in Belgium and in Europe.

In a study by **Alec J Ekeroma *et al;* 2015** in New Zealand Vitamin D deficiency was present in 109/259 (42%) of pregnant women in a south Auckland cohort. Of those enrolled in winter (June-August)/spring (September-November), Vitamin D deficiency was present in 43% of European, 67% of Māori, 80% of Pacific and 59% of women of other ethnic groups. Supplementation for all pregnant women during winter/spring could be an appropriate intervention for prevention of Vitamin D deficiency during pregnancy in New Zealand.

In a study in Switzerland during 2014-2015, Prevalence of Vitamin D Deficiency and Its Associations with Skin Color in Pregnant Women in the first trimester conducted by **Aline Richard *et al;* 2017**. The prevalence of Vitamin D deficiency (<20 ng/mL) in women in early pregnancy in Switzerland and evaluated the association of skin color with Vitamin D deficiency. In a single-center cohort study, the validated Fitzpatrick scale and objective melanin index were used to determine skin color. Of the 204 pregnant women included, 63% were Vitamin D deficient. The mean serum 25-hydroxyvitamin D concentration was 26.1 ng/mL (95% confidence interval (CI) 24.8–27.4) in Vitamin D–sufficient women and 10.5 ng/mL (95% CI 9.7–11.5) in women with deficiency. In the most parsimonious model, women with dark skin color were statistically significantly more often Vitamin D deficient compared to women with light skin color (OR 2.60; 95% CI 1.08–6.22; adjusted for age, season, Vitamin D supplement use, body mass index, smoking, parity). This calls for more intense counseling as one policy option to improve Vitamin D status during pregnancy, i.e., use of Vitamin D supplements during pregnancy, in particular for women with darker skin color.

In a study during 2008-2010 in Oslo, Norway;Vitamin D deficiency and supplementation in pregnancy in a multiethnic population-based cohort by **Ase R. Eggemoen *et al;* 2016**. Data are from the STORK Groruddalen project, which is a population-based, prospective cohort of 823 healthy women from 65 countries attending Child Health Clinics (CHC) for antenatal care in Groruddalen, Oslo, Norway, between May 2008 and March 2010. Severe deficiency (25(OH)D <25 nmol/L) was found at gestational weeks (GW) 15 in 45% of women from South Asia, 40% from the Middle East and 26% from Sub-Saharan Africa, compared to 2.5% in women from East Asia and 1.3% of women from Western Europe. Women from South Asia, the Middle East and Sub-Saharan Africa had mean values that were −28 (95 % CI:-33, −23), −24 (−29, −18) and −20 (−27, −13) nmol/L lower than in Western women, respectively. Ethnicity, education, season and intake of Vitamin D were independently associated with 25(OH)D. At GW 28, the mean 25(OH)D had increased from 23 (SD:7.8) to 47 (27) nmol/L ($p < 0.01$) in women who were recommended Vitamin D supplementation, with small or no change in women with sufficient Vitamin D levels at baseline.
They conclude that Vitamin D deficiency was prevalent among South Asian, Middle Eastern and African women. The serum levels of 25(OH)D increased significantly from GW 15 to 28 in Vitamin D deficient women who received a recommendation for supplementation. This recommendation of Vitamin D supplementation increased Vitamin D levels in deficient women.

A study in Riyadh, Saudi Arabia, by **F Serenius, *et. al*; 1984** concentrations of 25-hydroxy Vitamin D (25-(OH)D) were below 4 ng/ml in 30 of 119 maternal sera, in 11 of which they were undetectable. The median concentration of 25-(OH)D was 5.7 ng/ml. Vitamin D deficiency occurs in a significant proportion of pregnant Saudi women at term, and this is in a country which has more sunshine than any other and where no one is a vegetarian.

In a study Vitamin D study in pregnant women and their babies conducted by **Samar Al Emadi and Mohammed Hammoudeh; 2013** at Hamad Medical Corporation in Doha, Qatar between December 2007 and March 2010. Data were available for 97 pregnant women in the first trimester, 78 pregnant women in the second trimester and 61 in the third trimester and their newborns. During the first trimester, the lowest mean level of Vitamin D was 3 ng/ml and the highest level was 48 ng/ml with a mean Vitamin D level of 17.15 ng/ml. All other parameters were within normal range including calcium, phosphorus, *alkaline phosphatase*, albumin, total protein and PTH. At the second trimester, the lowest Vitamin D level was 5 ng/ml and highest was 70 ng/ml with a mean level of 29.08 ng/ml. At the third trimester, it was of 4 ng/ml and 59 ng/ml as the lowest and highest level respectively with a mean of 27.38 ng/ml. The range of Vitamin D level in 61 umbilical cord blood samples of the newborns was 3 and 59 ng/ml with a mean level of 22.36 ng/ml. During the study, calcium level was within normal range throughout pregnancy, no hypercalcemia were observed, and the mean calcium levels were 2.27 mmol/l, 2.21 mmol/l and 2.24 mmol/l during first, second and third trimester respectively.

Out of 97 patients, 8 patients dropped out from the study for several reasons, and 19 patients had pregnancy loss. Data were available for 97 women in the first trimester, 78 women in the second trimester and 61 women in the third trimester. The mean Vitamin D level in the first trimester and prior to starting Vitamin D supplementation was 17.15 ng/ml, 29.08 ng/ml in the second trimester, 27.3 ng/ml in third trimester and 22.36 ng/ml in newborns. There were no toxic levels of Vitamin D in any of the women at the second or third trimesters or in the newborns. The mean levels of Vitamin D in the second and third trimester were not significantly different in those women who were taking multivitamin supplementation and those who were not.

Another study conducted during 2010 in Riyadh, High Prevalence of Vitamin D Deficiency among Pregnant Saudi Women by **Nora A. Al-Faris; 2016**. Serum 25-hydroxy Vitamin D was measured by enzyme-linked immunosorbent assay in 160 pregnant women during the first trimester of pregnancy. Socio-demographic, lifestyle and maternal characteristics were collected and Vitamin D intake was assessed using a 24 hour dietary recall. Weight and height were measured using standardized methods. Vitamin D deficiency (25(OH)D< 50 nmol/l) and insufficiency (25(OH)D = 50–74 nmol/l) were reported in 50% and 43.8% of the study sample, respectively. Median serum 25(OH)D concentration was 49.9 nmol/L. Adequate Vitamin D intake (≥600 IU/day) was reported among only 8.1% of pregnant women. Age group, educational level, sun exposure frequency and daytime and daily practice of exercise were significantly associated with Vitamin D status. Overall, Vitamin D deficiency was common among pregnant Saudi women in Riyadh. Steps should be taken to address the current situation, including increased sunlight exposure, consumption of fatty fish, and Vitamin D supplements.

A study in Turkey by **Alagol F *et al; 2000*** *found that* women wearing traditional dress outdoors have a mean serum 25(OH)D concentration of 32 nmol/l compared with a mean of 9 nmol/l among those who are completely covered.

In a study High prevalence of Vitamin D insufficiency in pregnant women working indoors and residing in Guiyang, China, conducted by **Xiang F *et al*; 2013.** The mean serum level of 25(OH)D was 14.69±6.81 ng/ml. Vitamin D deficiency, insufficiency and sufficiency were found in 260 (83.6%), 39 (12.5%), and 12 (3.9%) women, respectively. The mean level of 25(OH)D in the third trimester was significantly higher than in the second trimester ($p<0.001$). The mean 25(OH)D level in summer (June, July, August) was significantly higher than in the other seasons ($p<0.001$). The 25(OH)D level in pregnant women compliant with pre-natal calcium or multivitamin supplements was higher than in those not taking supplements ($p<0.001$).

These results suggest that pregnant women residing in Guiyang urban area and working indoors are at high risk of Vitamin D insufficiency, particularly during spring, winter, and autumn, regardless of use of pre-natal calcium and multivitamins. Appropriate Vitamin D supplementation is necessary to improve maternal Vitamin D nutrition.

A pilot study by **Bassir M *et al*; 2001,** Vitamin D deficiency in Iranian mothers and their neonates. Blood samples were taken from 50 mothers (age 16-40 yr) and their neonates at term delivery in the largest Tehran hospital. The results showed that 80% of the women had 25-hydroxyvitamin D concentrations of less than 25 nmol/l. Mean maternal plasma calcium and alkaline phosphatase concentrations were in the normal range. The mean maternal serum immunoreactive parathyroid hormone concentration of women with hypovitaminosis D (i.e., 25-OHD levels <25 nmol/l) was above normal range and significantly different from that of women without hypovitaminosis D.

In a study by **Sharifi F *et al***; **2009** in Zanjan, Iran, 70 paires were enrolled in the study. Two of the mother's sample and nine of the cord bloods were not sufficient for the measurements and finally we had 68 samples from the mothers and 61 samples from the cords (61 pairs). Mean maternal serum 25(OH) D was 7.8 ±1.6 ng/mL, and cord blood 25(OH) D was 6.7 ±1.2 ng/Ml. 86% of the women and 75% of the newborns had 25(OH) D values below 10 ng/ml in winter. 46% of the mothers and 35% of the newborns had 25(OH)D values below 10 ng/ml in summer. Maternal serum 25(OH)D correlated positively with cord blood 25(OH)D (r:0.55, P:0.00). They observed a high prevalence of physiologically significant hypovitaminosis D among pregnant women and their newborns, the magnitude of which warrants public health intervention.

In a study Vitamin D Deficiency in Pregnant Women and Their Neonates conducted by **Maryam Abbasian*et al*; 2015** at Fatemiyeh Hospital of Shahroud, Iran from winter 2012 to spring 2013. Amounts of Vitamin D insufficiency (20-30 ng/ml) and deficiency (<20 ng/ml) in (mothers, neonates) were found to be (60.2%, 48.9%) and (1.1%, 2.5%) respectively. Calcium deficiency (<8.5 mg/dl) was present in 33.5% of mothers and 25% of neonates.

In a study in Bhaktapur, Nepal by **Johanne Haugen *et al*; 2016** found that, among the infants, the prevalence of Vitamin D insufficiency (25(OH)D <50 nmol/L) and deficiency (<30 nmol/L) were 3.6% and 0.6%, respectively, in contrast to 59.8% and 14.0% among their mothers. . The overall mean (±SD) total maternal plasma 25(OH)D was 47.4 ± 16.4 nmol/L and 201 (40.2%) had sufficient concentrations. The number with plasma 25(OH)D <50 nmol/L was 299 (59.8%), 70 (14.0%) had 25(OH)D<30 nmol/L and 476 (95.2%) had levels <75 nmol/L.

In A study of Prevalence of Vitamin D deficiency among pregnant women and its impact on feto maternal outcome conducted by **ShailajaNageshu*et al*; 2014** in KuppamAndra Pradesh**.** In the study period of the 80 women recruited, 3.8% were Christians, 78.8% were Hindus and 17.4% were Muslims. All women recruited for the study were >32 weeks gestation. It was found that 53.8% had insufficient serum Vitamin D concentrations and 13.8% were deficient for Vitamin D. The lowest Vitamin D concentrations (insufficient levels) were found in those with only one-two hours of sun exposure (65.1%), and 54.5% had deficient levels. Highest concentrations (11.5%) were found in those with two-four hours of sun exposure. There were no significant associations between Vitamin D concentrations and maternal outcome. The analysis showed a significant association between a deficient Vitamin D status (45.5%) and low birth weight (<2.5Kg) compared to 15.4% who had normal Vitamin D levels. An insufficient Vitamin D status was also related to a lower birth weight, but the association was not statistically significant. Among babies born to study subjects 84.6% had a normal birth weight of 2.5-3.5 kg with normal maternal Vitamin D levels, when compared to 36.4% with deficient maternal Vitamin D levels. The study did not find any significant association between Vitamin D levels and neonatal complications.

In a study Current Scenario of Vitamin D Status During Pregnancy in North Indian Population conducted by **Sheetal Sharma *et al;* 2015**. The prevalence of Vitamin D deficiency during pregnancy has been found to be 391 (93.5 %). Severe Vitamin D deficiency among pregnant patients was 34.44 % (144/418). The levels of serum 25(OH)D and serum calcium were significantly lower in severe deficient group than the adequate group [7.10 ± 1.49 vs. 38.90 ± 4.22 ng/ml (p = 0.001) and 7.13 ± 1.41 vs. 9.39 ± 0.88 ng/ml (p = 0.001).

In a study conducted by **Deepa Singh; 2016** in Udaipur, Rajasthan from July 2015 to April 2016, she found that Vitamin D deficiency is more common in the third trimester of pregnancy; the decrease may be due to less sun exposure. A gradual decrease in concentration of Vitamin D seen in this study from control down to third trimester is attributable to less exposure to sun as pregnancy grows. Since there is positive correlation between sunlight and Vitamin D status, the observed decrease in Vitamin D concentration and deficiency in pregnant women can be attributed to sedentary indoor lifestyle in which there is less exposure to sun. Another possible reason of Vitamin D deficiency in pregnant women is attributable to diets that are not rich in Vitamin D. Dietary sources consumed by pregnant women are very low in Vitamin D content. Indians are usually not eating salmon, sardines, tuna, mackerel which are rich in Vitamin D content. The explanation could also lie in prolonged deficiency of dietary calcium intake among poorer parts of Udaipur because of the expensive nature of milk and milk products.

In this study A total number of 200 women, out of which 150 were pregnant with 50 number in each trimester and 50 non pregnant from Udaipur city were selected for the study. They were in the age ranging from 20-35 years. The study was conducted for a period of 9 months. Women were divided into four categories A, B, C and D. Category A, B and C included pregnant women of first, second and third trimester while category D included non-pregnant women. Average total Vitamin D concentration in the first trimester was 21% less than the control group. Similarly, total Vitamin D concentration in the second trimester was 30.4% less than the control and in the third trimester it was 47.3% less than the control.

In another study High prevalence of Vitamin D deficiency among pregnant women and their newborns in northern India by **Sachan A *et al*; 2002** at Queen Mary's Hospital, King George Medical University, Lucknow**.** The most important finding in this study is the unexpectedly high prevalence of hypovitaminosis D among pregnant women. The physiologic relevance of the finding is substantiated by the negative correlation with PTH and the positive correlation with cord blood 25(OH)D.

Maternal serum 25(OH)D<10 ng/ml was found in 88 women (42.5%), whereas 138 women (66.7%) had values <15 ng/mL. Plasma PTH was significantly higher (125 ± 153 and 51 ± 39 pg/ml, respectively; $P< 0.001$) and cord blood 25(OH)D was significantly lower (5.2 ± 3.0 and 11.8 ± 5.9 ng/mL, respectively; $P< 0.001$) in mothers with 25(OH)D concentrations <10 ng/ml than in mothers with 25(OH)D concentrations >10 ng/ml. Maternal serum 25(OH)D showed a strong positive correlation with cord blood 25(OH)D ($r = 0.79$, $P< 0.001$) and a moderate negative correlation with maternal plasma PTH ($r = −0.35$, $P< 0.001$).

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